# HW4

# 22.211 Nuclear Reactor Physics I

## Due date 4/4/2018

**Using OpenMC and the libraries provided on the nsecluster, answer the following questions**

**OpenMC Documentation: http://openmc.readthedocs.io/en/latest/**

**How to run OpenMC on nsecluster.mit.edu?**

**https://wikis.mit.edu/confluence/display/nsecluster/Jupyter+Notebooks+for+22.211**

**Question 1: Heavy Water**

Fix the fuel pin diameter to 1 cm, coolant temperature at 600K and fuel temperature at 900K.

- **a)** Plot k as a function of the rod pitch (and find optimal value) for a square lattice of heavy water and fresh natural uranium oxide fuel.
- **b)** Compute the 4 factors (https://en.wikipedia.org/wiki/Four_factor_formula) and plot as a function of the pitch
- **c)** Find the Dysprosium oxide concentration (homogenously mixed in the fuel) needed to make the optimal design "exactly" critical

**Question 2: Graphite**

Fix the fuel pin diameter to 1 cm, coolant temperature at 600K and fuel temperature at 900K.

- **a)** Plot k as a function of the rod pitch (and find optimal value) for a square lattice of graphite and fresh natural uranium oxide fuel.
- **b)** Compute the 4 factors (https://en.wikipedia.org/wiki/Four_factor_formula) and plot as a function of the pitch
- **c)** Find the minimum uranium enrichment that can make reactor critical for the optimal geometry identified in a).

**Question 3: Light Water**

Fix the fuel pin diameter to 1 cm, coolant temperature at 600K and fuel temperature at 900K.

- a) Find the optimal pitch for both a triangular and square lattice assuming 4% enriched fresh uranium oxide fuel.
- b) Plot k as a function of volume ratio (moderator to fuel) for both lattices.